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(54) **STABLE SOLID PESTICIDAL PREPARATION.**

(57) A stable solid pesticidal preparation which contains a benzyl ester type synthetic pyrethroid having a cyano group in α -position and an organophosphate compound as effective ingredients supported on a mineral carrier, with at least one weakly acidic salt of an alkali or alkaline earth metal being incorporated therein.

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DESCRIPTION

A STABILIZED PESTICIDAL SOLID FORMULATION

1 TECHNICAL FIELD

The present invention relates to solid
formulations such as wettable powders, dusts, granules,
etc., and more particularly, to a stabilized pesticidal
5 solid formulation containing a synthetic benzyl ester
pyrethroid having a cyano group at the α -position (herein-
after referred to as pyrethroid) and an organophosphorus
acid ester compound.

BACKGROUND ART

10 Pesticides now in use are usually formulated
into various formulations so as to exert the efficacy of
the active ingredient by simple and efficient applications.

Of these various formulations, solid formula-
tions can easily be prepared by having the active
15 ingredient and necessary auxiliaries mixed with, or
adsorbed or adhered to, a suitable mineral carrier.

The decomposition with the lapse of time of the
active ingredient contained in pesticides may be the
causes of lowering in the efficacy of pesticides,
20 unexpected phytotoxicity owing to the decomposition
product and remarkable deterioration in the quality of
pesticides. Because of this, it becomes necessary to

1 apply pesticides in increased dosage rates or more
frequently, or to take measures for preventing secondary
harm to useful plants, which requires extra expense and
labor.

5 Further, when pesticides, because of their
instability, cannot be stored for a long period of time,
they are unsuitable for mass production on industrial
scales. Thus, whether or not the active ingredient
changes in quality with the lapse of time and a method for
10 preventing this change are subjects which should always be
examined.

Generally, when solid formulations containing a
pyrethroid and an organophosphorus acid ester compound are
packed particularly in a highly gas-tight container such
15 as aluminum-polyethylene laminate bag, it was found that
there is a possibility that decomposition of the
pyrethroid occurs during long-term storage under high-
temperature environments.

DISCLOSURE OF INVENTION

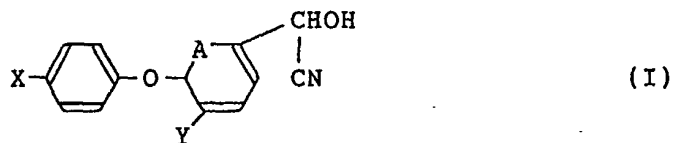
20 The present inventors have extensively studied
on solid formulations containing a pyrethroid and an
organophosphorus acid ester compound and being superior in
the stability of the active ingredients, and as a result,
have found that the expected object can be attained by
25 adding the alkali or alkaline earth metal salts of weak
acids as a stabilizing agent. The present inventors thus
completed the present invention.

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1 The present invention provides a stabilized
solid formulation of pesticide which comprises incorpo-
rating at least one of the foregoing stabilizing agents
into a solid formulation containing a pyrethroid and an
5 organophosphorus acid ester compound as the active
ingredient, supported on a mineral carrier, and which is
excellent in the stability of the pyrethroid with the
stability of the organophosphorus acid ester compound
being not damaged.

10 BEST MODE FOR CARRYING OUT THE INVENTION

The pyrethroid referred to in the present
invention is the ester of an α -cyanobenzyl alcohol, for
example, represented by the formula (I),



wherein A is a carbon or nitrogen atom, X is a hydrogen or
15 halogen atom, and Y is a hydrogen or fluorine atom, with
the carboxylic acid moiety of pyrethroidal insecticidal
compounds, i.e. a carboxylic acid such as cyclopropane-
carboxylic acids, substituted phenylacetic acids, etc.,
and further specifically, the following compounds may be
20 mentioned. Of course, the pyrethroid of the present
invention is not limited to these compounds, and also it
is a matter of course that the pyrethroid includes the

- 1 geometrical and optical isomers of these compounds and mixtures of these isomers in any proportion.

| Compound No. | Name of compound |
|--------------|---|
| | (1) α -Cyano-3-phenoxybenzyl |
| 5 | 2-(4-chlorophenyl)-3-methylbutyrate |
| | (2) (S)- α -cyano-3-phenoxybenzyl |
| | (S)-2-(4-chlorophenyl)-3-methylbutyrate |
| | (3) α -Cyano-3-phenoxybenzyl 2,2,3,3-tetramethylcyclopropanecarboxylate |
| 10 | (4) α -Cyano-3-phenoxybenzyl 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclopropanecarboxylate |
| | (5) α -Cyano-3-(4-bromophenoxy)benzyl 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclopropanecarboxylate |
| 15 | (6) α -Cyano-3-(4-fluorophenoxy)benzyl 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclopropanecarboxylate |
| | (7) α -Cyano-3-(3-bromophenoxy)benzyl 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclopropanecarboxylate |
| 20 | (8) α -Cyano-3-(4-chlorophenoxy)benzyl 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclopropanecarboxylate |
| 25 | (9) α -cyano-3-phenoxybenzyl chrysanthemate |

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- 1 (10) α -Cyano-3-(4-bromophenoxy)benzyl
2-(4-chlorophenyl)-3-methylbutyrate
- (11) α -Cyano-3-(3-bromophenoxy)benzyl
2-(4-chlorophenyl)-3-methylbutyrate
- 5 (12) α -Cyano-3-(4-chlorophenoxy)benzyl
2-(4-chlorophenyl)-3-methylbutyrate
- (13) α -Cyano-3-(4-fluorophenoxy)benzyl
2-(4-chlorophenyl)-3-methylbutyrate
- (14) α -Cyano-3-phenoxybenzyl
10 2-(4-bromophenyl)-3-methylbutyrate
- (15) α -Cyano-3-phenoxybenzyl
2-(4-tert-butylphenyl)-3-methylbutyrate
- (16) α -Cyano-3-phenoxybenzyl
15 2-(3,4-methylenedioxyphenyl)-3-methyl-
butyrate
- (17) (S)- α -cyano-m-phenoxybenzyl (1R,
3R)-2,2-dimethyl-3-(2,2-dibromovinyl)-
cyclopropanecarboxylate
- (18) α -Cyano-(4-fluoro-3-phenoxybenzyl)
20 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclo-
propanecarboxylate
- (19) α -Cyano-3-phenoxybenzyl 2-chloro-4-
(trifluoromethyl)anilino-3-methylbutyrate
- (20) Cyano-(5-phenoxy-2-pyridyl)methyl
25 2,2-dimethyl-3-(2,2-dichlorovinyl)cyclo-
propanecarboxylate

- 1 (21) α -Cyano-3-phenoxybenzyl 2,2-
dimethyl-3-(1,2,2,2-tetrabromoethyl)
cyclopropanecarboxylate
- (22) α -Cyano-3-phenoxybenzyl 2,2-di-
5 methyl-3-(1,2-dichloro-3,3-dibromo)cyclo-
propanecarboxylate
- (23) α -Cyano-3-phenoxybenzyl 1-(4-
ethoxyphenyl)-2,2-dichlorocyclopropane-1-
carboxylate
- 10 (24) α -Cyano-3-phenoxybenzyl 2,2-
dimethyl-3-(2-chloro-3-trifluoromethyl-
vinyl)cyclopropanecarboxylate
- (25) α -Cyano-3-phenoxybenzyl 2-(4-
difluoromethoxyphenyl)-3-methylbutyrate

15 Further, as examples of the organophosphorus
acid ester compound, there may be mentioned for example
(thio, dithio, trithio)phosphoric acid esters, amido-
(thio)phosphoric acid esters, (thio, dithio)phosphonic
acid esters, etc. Further specifically, the following
20 compounds may be mentioned, but the organophosphorus acid
ester compound of the present invention is not of course
limited to these compounds.

| 1 | Compound No. | Name of compound |
|----|--------------|--|
| | (26) | O,O-dimethyl S-(1,2-dicarboethoxy)- ethylphosphorodithioate |
| | (27) | O,O-dimethyl S-methylcarbamoyl- methylphosphorodithioate |
| 5 | (28) | 2-Methoxy-4H-1,3,2-benzodioxaphosphorine-2-sulfide |
| | (29) | O,O-dimethyl S-(α -ethoxycarbonylbenzyl)phosphorodithioate |
| 10 | (30) | O,O-dimethyl O-4-nitro-m-tolylphosphorothioate |
| | (31) | S-2,3-dihydro-5-methoxy-2-oxo-1,3,4-thiadiazol-3-ylmethyl O,O-dimethylphosphorodithioate |
| 15 | (32) | O-4-cyanophenyl O,O-dimethylphosphorothioate |
| | (33) | O,O-diethyl O-3,5,6-trichloro-2-pyridylphosphorothioate |
| | (34) | O,O-dimethyl O-2,2-dichlorovinylphosphate |
| 20 | (35) | O,O-dimethyl O-(4-methylthio-3-methylphenyl)phosphorothioate |
| | (36) | O,O-diethyl S-(N-ethoxycarbonyl-N-carbamoylmethyl)phosphorothiolothionate |
| 25 | (37) | O,O-dimethyl S-(2-ethylthioethyl)phosphorothiolothionate |

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- 1 (38) O,O-diethyl S-(2-ethylthioethyl)-
 phosphorothiolothionate
- (39) O,O-dimethyl S-(phthalimidomethyl)-
 phosphorothiolothionate
- 5 (40) O,O-dimethyl S-2-(isopropylthio)-
 ethylphosphorothiolothionate
- (41) O,O-dimethyl O-2,6-dichloro-4-
 methylphenylphosphorothioate
- (42) O-ethyl O-5-methyl-2-nitrophenyl
10 sec-butylphosphoroamidothioate
- (43) O-ethyl O-(4-nitrophenyl)phenyl-
 phosphonothioate

The contents of the pyrethroid and organo-phosphorus acid ester compound in the solid formulations of the present invention are generally from about 0.1 to about 10 wt. % and from about 5 to about 50 wt. %, respectively, but these contents may properly be changed depending upon intended uses.

As examples of the mineral carrier used in preparing the solid formulations, there may be mentioned diatomaceous earth, zeolite, bentonite, kaolinite clays, sericite clays, attapulgite, pyrophyllite, synthetic hydrated silicon dioxide (white carbon), etc. which are commonly used in pesticidal formulations.

25 The stabilizing agent used in the present invention is the alkali or alkaline earth metals salts of the weak acids such as for example alkaline earth metal

1 carbonates, acetates and silicates, and alkali or alkaline
earth metal phosphate, borates and citrates. Further
specifically, there may be mentioned calcium carbonate,
magnesium carbonate, barium carbonate, calcium acetate,
5 magnesium acetate, calcium silicate, talc, calcium-
bentonite, sodium phosphate, disodium hydrogenphosphate,
dicalcium hydrogenphosphate, sodium polyphosphate, sodium
pyrophosphate, sodium tripolyphosphate, sodium borate,
sodium citrate, etc.

10 As to the amount of the stabilizing agent added,
although it depends upon the kind of the agent, a range of
from about 3 to about 40 parts by weight based on 100
parts by weight of the organophosphorus acid ester
compound will suffice from the standpoints of the stabili-
15 ty of active ingredient and formulation. The amount,
however, is not limited to this range.

In the present invention, there may be incorpo-
rated pesticidal active ingredients other than the
pyrethroid and organophosphorus acid ester compound and
20 auxiliaries necessary according to various types of
formulations such as wettable powders, dusts, granules,
etc.

The present invention will be illustrated in
more detail with reference to the following formulation
25 examples, comparative examples and test examples, but it
is not limited to these examples.

Hereupon, the pyrethroid and organophosphorus
acid ester compound, which are an active ingredient, are

- 1 shown by the foregoing Compound No., and all parts are by weight.

Formulation example 1

- 3 Parts of a pyrethroid (1) and 30 parts of an
5 organophosphorus acid ester compound (26) are mixed with 5
parts of Sorpol[®] 5060 (surface active agent produced by
Toho Kagaku Co., Ltd.), 30 parts of Tokusil[®] GU-N (white
carbon produced by Tokuyama Soda Co., Ltd.) and 5 parts of
each of the stabilizing agents shown in Table 1 described
10 later, and the whole is made up to 100 parts with a
kaolinite clay. After mixing, each mixture is finely
pulverized to obtain a wettable powder of the present
invention.

Formulation example 2

- 15 0.5 Part of a pyrethroid (2) and 10 parts of an
organophosphorus acid ester compound (29) are mixed with
10 parts of Tokusil[®] GU-N (described above) and 1 part
of each of calcium carbonate and sodium polyphosphate, and
the whole is made up to 100 parts with a kaolinite clay.
20 After mixing, each mixture is finely pulverized to obtain
a dust of the present invention.

Formulation example 3

- 1 Part of a pyrethroid (4) and 5 parts of an
organophosphorus acid ester compound (26) are mixed with 1
25 part of Sorpol[®] 5029-0 (surface active agent produced

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1 by Toho Kagaku Co., Ltd.), 5 parts of Tokusil[®] GU-N
(described above), 30 parts of bentonite and 0.5 part of
talc, and the whole is made up to 100 parts with a
kaolinite clay. After mixing, the mixture is granulated
5 to obtain a granule of the present invention.

Formulation example 4

3 Parts of each of pyrethroids (2), (3), (4),
(9) and (17) and 30 parts of each of organophosphorus acid
ester compounds (26), (28), (29) and (31) are mixed with 5
10 parts of Sorpol[®] 5060 (described above), 30 parts of
Tokusil[®] GU-N (described above) and 5 parts of calcium
carbonate, and the whole is made up to 100 parts with a
kaolinite clay. After mixing, each mixture is finely
pulverized to obtain a wettable powder of the present
15 invention.

Formulation example 5

3 Parts of a pyrethroid (2) and 30 parts of an
organophosphorus acid ester compound (26) are mixed with 5
parts of Sorpol[®] 5060 (described above), 30 parts of
20 Tokusil[®] GU-N (described above) and from 1 to 10 parts
of each of calcium carbonate, disodium hydrogenphosphate,
sodium tripolyphosphate and calcium silicate, and the
whole is made up to 100 parts with a kaolinite clay.
After mixing, each mixture is finely pulverized to obtain
25 a wettable powder of the present invention.

1 Formulation example 6

3 Parts of a pyrethroid (2) and 30 parts of an organophosphorus acid ester compound (26) are mixed with 5 parts of Sorpol [®] 5060 (described above) and 30 parts of
5 Tokusil [®] GU-N (described above), and the whole is made up to 100 parts with calcium carbonate. After mixing, the mixture is finely pulverized to obtain a wettable powder of the present invention.

Formulation example 7

10 3 Parts of each of pyrethroids (2), (3), (4), (9), (24) and (25) and 30 parts of each of organophosphorus acid ester compounds (26), (27), (29) and (31) are mixed with 5 parts of Sorpol [®] 5060 (described above), 30 parts of Tokusil [®] GU-N (described above) and
15 5 parts of sodium polyphosphate, and the whole is made up to 100 parts with a kaolinite clay. After mixing, each mixture is finely pulverized to obtain a wettable powder of the present invention.

Comparative example 1

20 3 Parts of each of pyrethroids (1), (2), (3), (4), (9), (17), (24) and (25) and 30 parts of each of organophosphorus acid ester compounds (26), (27), (28), (29) and (31) are mixed with 5 parts of Sorpol [®] 5060 (described above) and 30 parts of Tokusil [®] GU-N
25 (described above), and the whole is made up to 100 parts with a kaolinite clay. After mixing, each mixture is

- 1 finely pulverized to obtain a mixed wettable powder of the
pyrethroid and organophosphorus acid ester compound.

Comparative Example 2

0.5 Part of a pyrethroid (2) and 5 parts of an
5 organophosphorus acid ester compound (29) are mixed with
10 parts of Tokusil[®] GU-N (described above), and the
whole is made up to 100 parts with a kaolinite clay.
After mixing, the mixture is finely pulverized to obtain a
mixed dust of the pyrethroid and organophosphorus acid
10 ester compound.

Test example 1

Each of the wettable powders (having a composi-
tion described in Table 1) obtained in Formulation example
1 and Comparative example 1 was packed in an airtight
15 aluminum-polyethylene laminate bag and stored for 1 month
in a constant-temperature apparatus kept at 60°C. There-
after, the remaining percentages (the percentages of the
amounts of the respective active ingredients remained
without having been decomposed) were examined by gas
20 chromatography. The results are shown in Table 1.

Table 1

| Stabilizing agent | Remaining percentage after storage at 60°C for 1 month (%) | |
|-----------------------------|--|--|
| | Pyrethroid (1) | Organophos- phorus acid ester compound (26) |
| No addition | 60.4 | 81.4 |
| Calcium carbonate | 97.7 | 87.4 |
| Magnesium carbonate | 96.1 | 87.2 |
| Barium carbonate | 94.9 | 84.3 |
| Calcium silicate | 98.8 | 87.8 |
| Calcium acetate | 92.4 | 78.4 |
| Disodium hydrogenphosphate | 94.7 | 83.1 |
| Dicalcium hydrogenphosphate | 93.5 | 85.5 |
| Sodium phosphate | 92.4 | 88.9 |
| Sodium borate·decahydrate | 95.4 | 85.5 |
| Sodium polyphosphate | 99.9 | 93.4 |
| Talc | 94.5 | 93.4 |
| Sodium citrate | 93.6 | 78.5 |

1 Test example 2

Each of the dusts obtained in Formulation example 2 and Comparative example 2 was packed in an airtight aluminum-polyethylene laminate bag and stored for 2 weeks in a constant-temperature apparatus kept at 60°C.

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- 1 Thereafter, the remaining percentages of the active ingredients were examined by gas chromatography. The results are shown in Table 2.

Table 2

| Stabilizing agent | Remaining percentage after storage at 60°C for 2 weeks (%) | |
|----------------------|--|--|
| | Pyrethroid (2) | Organophosphorus acid ester compound (29) |
| No addition | 62.0 | 97.4 |
| Calcium carbonate | 81.8 | 97.5 |
| Sodium polyphosphate | 87.3 | 97.8 |

Test example 3

- 5 Each of the wettable powders (having a composition described in Table 3) obtained in Formulation example 4 and Comparative example 1 was packed in an airtight aluminum-polyethylene laminate bag and stored for 1 month in a constant-temperature apparatus kept at 60°C.
- 10 Thereafter, the remaining percentages of the active ingredient were examined by gas chromatography. The results are shown in Table 3.

Table 3

| Pyrethroid | Organophosphorus acid ester compound | Storage condition | No addition | | Addition of 5% calcium carbonate | |
|------------|--------------------------------------|-------------------|-------------|------|----------------------------------|------|
| | | | a | b | a | b |
| (2) | (28) | 50°C, 14 days | 80.3 | 83.7 | 99.9 | 89.8 |
| (2) | (31) | 60°C, 14 days | 25.7 | 88.6 | 82.2 | 86.8 |
| (3) | (26) | 60°C, 1 month | 80.8 | 87.1 | 98.0 | 88.3 |
| (4) | (26) | 60°C, 1 month | 87.5 | 88.1 | 96.4 | 87.3 |
| (4) | (29) | 60°C, 20 days | 69.0 | 84.9 | 97.1 | 89.3 |
| (9) | (26) | 60°C, 1 month | 88.5 | 91.2 | 96.4 | 86.6 |
| (17) | (26) | 60°C, 1 month | 89.8 | 89.5 | 98.9 | 94.5 |

a: Remaining percentage of pyrethroid (%)

b: Remaining percentage of organophosphorus acid ester compound

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1 Test example 4

Each of the wettable powders (having a composition described in Table 4) obtained in Formulation example 5 and Comparative example 1 was packed in an airtight aluminum-polyethylene laminate bag and stored for 1 month in a constant-temperature apparatus kept at 60°C. Thereafter, the remaining percentages of the active ingredients were examined by gas chromatography. The results are shown in Table 4.

Table 4

| Stabilizing agent | Amount of stabilizing agent added (part by weight) | Remaining percentage after storage at 60°C for 1 month (%) | |
|----------------------------|--|--|---|
| | | Pyrethroid (2) | Organophosphorus acid ester compound (26) |
| No addition | 0 | 62.5 | 82.1 |
| Calcium carbonate | 1 | 97.3 | 86.5 |
| Calcium carbonate | 2 | 97.1 | 85.8 |
| Calcium carbonate | 3 | 97.7 | 87.3 |
| Calcium carbonate | 5 | 97.7 | 87.4 |
| Calcium carbonate | 10 | 97.2 | 88.2 |
| Calcium silicate | 1 | 87.9 | 83.9 |
| Calcium silicate | 3 | 96.2 | 79.8 |
| Disodium hydrogenphosphate | 1 | 88.3 | 86.4 |
| Disodium hydrogenphosphate | 2 | 94.2 | 86.1 |

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